

REMARKS

Applicant's claims have been amended to better clarify Applicants' claimed invention. Claims 1, 16, 18, and 21, have been amended to include at least first and second cathodes separated by a gap, said first cathode comprising a first magnetic polarity and said second cathode comprising a second magnetic polarity. Support can be found in the Specification at Paragraph [0042] in the published Application, and in FIG. 1. Magnetic pole 2 is disposed on the end of magnet 10 having a first magnetic polarity, i.e. "N." FIG. 1. Thus, magnetic pole 2 has a first magnetic polarity.

Magnetic pole 3 is disposed on the end of magnet 9 having a second magnetic polarity, i.e. "S". FIG. 1. Thus, magnetic pole 3 has a second magnetic polarity. "The device 22 includes a magnet shunt 4, permanent magnets 9 and 10, and magnetic poles 2 and 3. These parts generate a magnetic device 11 in the gap 23 between the pole pieces 2 and 3." Paragraph [0042]. Magnetic poles also comprise cathodes in an electrical circuit. Apparatus 22 comprises "(2) cathodes comprised of pole pieces 2 and 3." Paragraph [0042]. Therefore, Applicant's device includes a first cathode having a first magnetic polarity and a second cathode having a second polarity.

Additional support can be found in Specification at Paragraphs [0055], [0057], and in FIG. 5. "As best shown in FIG. 5, the device 100 includes permanent magnets 109, 110 that are positioned between magnetic poles 102, 103, and a shunt 104. In this example, the magnetic poles 102, 103 and the shunt 104 are formed of ferromagnetic material, and the magnets 109, 110 cooperate with the magnetic poles 102, 103, and the shunt 104 to form a magnetic circuit." Paragraph [0055]. Thus, magnetic pole 102 has a first magnetic polarity and

magnetic pole has a second magnetic polarity. Magnetic poles 102 and 103 further comprise cathodes. "The electrical circuit also includes cathodes including the magnetic poles 102, 103 . . ." Paragraph [0057]. Therefore, Applicant's device includes a first cathode having a first magnetic polarity and a second cathode having a second polarity.

Additional support can be found at Paragraphs [0078], [0079], and FIG. 9. "As before, the magnetic circuit is made up of magnetic poles 202, 203, the gap between these poles, permanent magnets 209, 210, and magnet shunt 204." Paragraph [0078]. "In this example, the poles 202, 203 act as cathodes . . ." Paragraph [0079]. Therefore, Applicant's device includes a first cathode having a first magnetic polarity and a second cathode having a second polarity.

Claim 7 has been amended to address a Section 112, second paragraph, objection.

No new matter has been entered. Reexamination and reconsideration of the application, as amended, is respectfully requested.

Claims 1 - 33 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Flemming (U.S. Pat. No. 3,955,118).

Claim 7 stands objected to under 35 U.S.C. 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Applicant responds as follows:

Flemming teaches a "Pennington-type cold-cathode ion source." Col. 2 / Line 50.

Flemming nowhere teaches an apparatus comprising a first cathode having a first magnetic polarity in combination with a second cathode having a second magnetic polarity.

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It is well-settled that “[t]o establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art.” MPEP 2143.03; *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). Applicant’s amended claims 1, 16, 18, and 21, recite a plasma treatment apparatus which comprising at least first and second cathodes separated by a gap, said first cathode comprising a first magnetic polarity and said second cathode comprising a second magnetic polarity.

Flemming nowhere teaches or suggests an apparatus comprising a first cathode having a first magnetic polarity in combination with a second cathode having a second magnetic polarity. This being the case, Applicant respectfully submits that claims 1, 16, 18, and 21, as amended herein, are patentable over Flemming.

Claims 2 through 15, inclusive, depend, directly or indirectly, from claim 1. Under 35 U.S.C. § 112, fourth paragraph, “a claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers.” Therefore, claims 2 through 15, inclusive, as amended herein, include all the elements of claim 1, as amended herein. “If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious.” MPEP 2143.03; *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed.Cir. 1988).

For the reasons set forth above, Applicant respectfully submits that Flemming does not render obvious claim 1, as amended herein. This being the case, Applicant further respectfully submits that claims 2 through 15, as amended herein, are non-obvious over Flemming.

Claim 17 depends from claim 16. Under 35 U.S.C. § 112, fourth paragraph, “a claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers.” Therefore, claim 17, as amended herein, includes all the elements of claim 17,

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as amended herein. "If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious." MPEP 2143.03; *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed.Cir. 1988).

For the reasons set forth above, Applicant respectfully submits that Flemming does not render obvious claim 16, as amended herein. This being the case, Applicant further respectfully submits that claim 17, as amended herein, is non-obvious over Flemming.

Claims 19 and 20 depend from claim 18. Under 35 U.S.C. § 112, fourth paragraph, "a claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers." Therefore, claims 19 and 20, as amended herein, include all the elements of claim 18, as amended herein. "If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious." MPEP 2143.03; *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed.Cir. 1988).

For the reasons set forth above, Applicant respectfully submits that Flemming does not render obvious claim 18, as amended herein. This being the case, Applicant further respectfully submits that claims 19 and 20, as amended herein, are non-obvious over Flemming.

Claims 22 through 26, inclusive, depend from claim 21. Under 35 U.S.C. § 112, fourth paragraph, "a claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers." Therefore, 22 through 26, inclusive, as amended herein, include all the elements of claim 21, as amended herein. "If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious." MPEP 2143.03; *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed.Cir. 1988).

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For the reasons set forth above, Applicant respectfully submits that Flemming does not render obvious claim 21, as amended herein. This being the case, Applicant further respectfully submits that claims 22 through 26, inclusive, as amended herein, are non-obvious over Flemming.

Claims 27 through 33, inclusive, depend from two or more of claims 1, 16, 18, or 21. Under 35 U.S.C. § 112, fourth paragraph, "a claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers." "If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious." MPEP 2143.03; *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed.Cir. 1988).

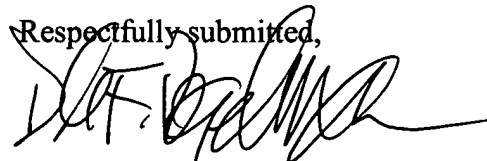
For the reasons set forth above, Applicant respectfully submits that Flemming does not render obvious any of claims 1, 16, 18, or 21, as amended herein. This being the case, Applicant further respectfully submits that claims 27 through 33, inclusive, as amended herein, are non-obvious over Flemming.

Having dealt with all of the outstanding objections and/or rejections of the claims, Applicant submits that the application as amended is in condition for allowance, and an allowance at an early date is respectfully solicited. In the event there are any fee deficiencies or additional fees are payable, please charge them (or credit any overpayment) to our Deposit Account No. 502262.

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Respectfully submitted,



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CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450 on May 2, 2003, at Tucson, Arizona.

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EXHIBIT “1”

COMPLETE LISTING OF THE CLAIMS

SERIAL NO. 10/036,067

APT 01.01

1. (currently amended) A plasma treatment apparatus, comprising:

at least first and second cathodes separated by a gap, said first cathode comprising a first exposed cathode surface and a first magnetic polarity, said second cathode comprising a second exposed cathode surface and a second magnetic polarity, and said first exposed cathode surface oriented non-parallel to said second exposed cathode surface;

a set of magnets operative to generate a magnetic field exiting from one of the cathodes and entering the other of the cathodes, thereby crossing the gap;

said magnetic field comprising a first magnetic field portion crossing the gap and passing through said first exposed cathode surface, said first magnetic field portion comprising magnetic field lines having a maximum field strength of at least 100 Gauss;

at least one anode structure positioned to create an electric field extending from the cathodes to the anode structure, at least a portion of said electric field crossing said magnetic field and forming a closed-loop electron containment region within said magnetic field, a sufficient voltage between the anode structure and the cathodes operative to form a plasma within the magnetic field when a gas is present near the containment region at a gas pressure between 0.1 and 100 mTorr; and

at least one substrate positioned to be treated by said plasma.

2. (original) The apparatus of claim 1 wherein the substrate is positioned to be treated by the plasma with a treatment selected from the group consisting of: a chemical vapor deposition process, a surface modification process, an etching process, a sputter-coating process, and combinations thereof.

3. (original) The apparatus of claim 1 wherein the magnetic field comprises a mirror-type magnetic field at least in a peripheral portion of the magnetic field.

4. (original) The apparatus of claim 1 wherein the first exposed cathode surface faces the substrate.

5. (original) The apparatus of claim 4 wherein the first exposed cathode surface extends over a length measured along the gap and a width measured transverse to the length, and wherein the width is at least 1 cm.

6. (original) The apparatus of claim 1 wherein at least one of the cathodes comprises a non-planar cathode surface.

7. (currently amended) The apparatus of claim 6 wherein at least one of the cathodes comprises a facing cathode surface having a shape ~~shaped~~ selected from the group consisting of: a point, a bevel, a rounded surface, a stepped surface, a ridged surface, and combinations thereof.

8. (original) The apparatus of claim 1 wherein the first cathode comprises a facing cathode surface oriented to face the second cathode, wherein the first exposed cathode surface has a length extending along the gap and width W1 measured transverse to the length, wherein the facing cathode surface has a width W2 measured transverse to the length, and wherein $W1/W2$ is no less than 0.2.

9. (original) The apparatus of claim 8 wherein the length is greater than the width W2.

10. (original) The apparatus of claim 8 wherein the width W1 is no less than 1 cm.

11. (original) The apparatus of claim 1 wherein the cathodes comprise ends and a central portion, and wherein the cathodes are shaped such that the gap is wider at the ends than at the central portion.

12. (original) The apparatus of claim 11 wherein the ends of the cathodes are beveled.

13. (original) The apparatus of claim 1 wherein the magnetic field comprises a maximum strength magnetic field line, wherein the maximum strength magnetic field line has a maximum magnetic field strength B_1 adjacent one of the cathodes and a minimum magnetic field strength B_2 at a central portion of the gap, and wherein B_1/B_2 is greater than 2.

14. (original) The apparatus of claim 13 wherein B_1/B_2 is greater than 4.

15. (original) The apparatus of claim 1 wherein the electron containment region is centered in a plane that is oriented perpendicular ($\pm 45^\circ$) to a portion of the substrate adjacent to the gap.

16. (currently amended) A plasma treatment apparatus, comprising:

at least ~~two~~ first and second cathodes separated by a gap, said first cathode comprising a first magnetic polarity, and said second cathode comprising a second magnetic polarity;

a set of magnets operative to generate a magnetic field exiting from one of the cathodes and entering the other of the cathodes, thereby crossing the gap;

at least one anode structure positioned to create an electric field extending from the cathodes to the anode structure, at least a portion of said electric field crossing said magnetic field and forming a closed-loop electron containment region within said

magnetic field, a sufficient voltage between the anode structure and the cathodes operative to form a plasma within the magnetic field when a gas is present near the containment region at a gas pressure between 0.1 and 100 mTorr; and at least one substrate positioned to be treated by said plasma;

wherein the magnetic field is asymmetrical with respect to a central axis of the gap extending between the cathodes, and wherein the electron containment region extends farther away from the central axis on one side of the gap than on the other side of the gap.

17. (original) The apparatus of claim 16 wherein the substrate is positioned on said one side of the gap.

18. (currently amended) A plasma treatment apparatus, comprising:
at least two first and second cathodes separated by a gap, said first cathode comprising a first magnetic polarity, and said second cathode comprising a second magnetic polarity;

a set of magnets operative to generate a magnetic field exiting from one of the cathodes and entering the other of the cathodes, thereby crossing the gap;

at least one anode structure positioned to create an electric field extending from the cathodes to the anode structure, at least a portion of said electric field crossing said magnetic field and forming a closed-loop electron containment region within said magnetic field, a sufficient voltage between the anode structure and the cathodes operative to form a plasma within the magnetic field when a gas is present near the containment region at a gas pressure between 0.1 and 100 mTorr;

at least one substrate positioned to be treated by said plasma; and

a set of ferromagnetic elements magnetically coupled to the set of magnets to provide a ferromagnetic return magnetic path, thereby enhancing the magnetic field across the gap.

19. (original) The apparatus of claim 18 wherein the electron containment region comprises first and second portions situated on respective sides of the gap, and wherein the second portion is situated between the gap and at least one element selected from the group consisting of: the set of magnets and the set of ferromagnetic elements.

20. (original) The apparatus of claim 18 wherein the set of magnets and the set of ferromagnetic elements are included in a magnetic circuit, and wherein the gap is the largest non-ferromagnetic opening in the magnetic circuit.

21. (currently amended) A plasma treatment apparatus, comprising:

at least ~~two~~ first and second cathodes separated by a gap, said first cathode comprising a first magnetic polarity, and said second cathode comprising a second magnetic polarity;

a set of magnets operative to generate a magnetic field exiting from one of the cathodes and entering the other of the cathodes, thereby crossing the gap;

at least one anode structure positioned to create an electric field extending from the cathodes to the anode structure, at least a portion of said electric field crossing said magnetic field and forming a closed-loop electron containment region within said magnetic field, a sufficient voltage between the anode structure and the cathodes operative to form a plasma within the magnetic field when a gas is present near the containment region at a gas pressure between 0.1 and 100 mTorr;

at least one substrate positioned to be treated by said plasma; an enclosure extending from the cathodes around a portion of the electron containment region positioned away from the substrate; and

a source of process gas positioned within the enclosure.

22. (original) The apparatus of claim 21 wherein a major portion of the process gas from the source passes through the plasma containment region in leaving the enclosure.

23. (original) The apparatus of claim 21 wherein the source of process gas comprises a tube positioned within the enclosure, said tube comprising gas-release openings.

24. (original) The apparatus of claim 21 wherein the source of process gas comprises an evaporation source.

25. (original) The apparatus of claim 21 wherein the source of process gas comprises a sputter source.

26. (original) The apparatus of claim 21 wherein the source is positioned between the enclosure and a portion of the electron containment region.

27. (original) The apparatus of claims 1, 16, 18 or 21 wherein the cathodes comprise removable shells.

28. (original) The apparatus of claims 1, 18 or 21 wherein the magnetic field is asymmetrical with respect to a central axis of the gap extending between the cathodes, and wherein the electron containment region extends farther from the central axis on a front side of the gap facing the substrate than on a back side of the gap facing away from the substrate.

29. (original) The apparatus of claims 1, 16, 18 or 21 wherein the cathodes are asymmetrical with respect to a central axis of the gap.

30. (original) The apparatus of claims 1, 16, 18 or 21 wherein the set of magnets comprises a permanent magnet.

31. (original) The apparatus of claims 1, 16, 18 or 21 wherein the set of magnets comprises an electromagnet.

32. (original) The apparatus of claims 1, 16, 18 or 21 wherein the gap is elongated along a length axis, and wherein each of the cathodes comprises a plurality of segments positioned adjacent to one another along the length axis.

33. (original) The apparatus of claims 1 or 18 wherein the at least one substrate is positioned on both sides of the gap for treatment by the plasma.